IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	10/574,859
Applicants	:	Oder, Robin R. et al.
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Title	:	Apparatus and Method for Continuous Separation of Magnetic Particles from Non-Magnetic Fluids
Group Art Unit	:	1797
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Commissioner for Patents
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DECLARATION OF DR. ROBIN R. ODER AND MR. RUSSELL E. JAMISON

I, Robin R. Oder, Ph.D., and I, Russell E. Jamison, declare as follows.

1. I, Robin Oder, have over thirty years' experience in developing and commercializing innovative magnetic separation technology. I received my Ph.D. in physics from MIT and spent five years at MIT's Francis Bitter National Magnet Laboratory doing research in solid state physics and superconductivity. At the J.M. Huber Corporation in Macon, GA, I specified the design and oversaw the installation of the first commercial High Gradient Magnetic Separator (HGMS) for kaolin clay beneficiation. This process is now used world-wide in the kaolin industry. At the Bechtel Corporation in San Francisco I prepared conceptual engineering evaluations of HGMS in other industries. I joined the Gulf Science and Technology Company as Director of Coal Technology where I initiated a research and development program sponsored by the Pittsburg & Midway Coal Mining Company, a Gulf Oil subsidiary. I founded ETCi (currently the assignee of the above-identified technology) in 1982 to develop separation and fine grinding technologies. In 1997 I spun off Magnetic Applications Group, Inc., which was merged into ETCi following the formation of MagMill Co. LLC in 2006 for which I am Technical Director. In addition, I have been a Phoebe Apperson Hearst lecturer at the University of

California, Berkeley, a Case Western Reserve University Centennial Scholar, and an invited lecturer in Coal Technology at the University of Houston. I served as an elected officer of the Pittsburgh Section of the American Institute of Chemical Engineers and am a regional editor of the international journal, Coal Preparation. I have authored over 150 publications and company reports in superconductivity, magnetism, cryogenics, metals and alloys, coal technology, water processing, paper technology, and clay mineralogy, and I hold a number of patents in the technology areas of magnetic separation, coal gasification, electrostatic and magnetostatic coalescence, and recovery of Helium 3 from extraterrestrial resources.

2. I, Russell E. Jamison, was employed by EXPORTech Company, Inc. for eighteen years, working in the area of magnetic separation. I am inventor or co-inventor of five issued U.S. Patents. I have been a co-author of numerous publications and company reports on magnetic separation technology. I am now employed as a design specialist by a company which Dr. Oder co-founded, which company is commercializing a technology for which Dr. Oder and I are co-inventors.

3. At the time we developed the improvements embodied and claimed in Published U.S. Application No. 20070056912, it was counterintuitive to take the apparatus of WO 03/064052 A2 and to try to improve it by, among other modifications, removing the magnetic rods from inside the chamber. Prior to the development of the present invention, as claimed in claims to be submitted to the United States Patent and Trademark Office simultaneously with this Declaration, we believed and others skilled in the art would likewise have believed that to remove the magnetic rods from the separation chamber of the WO 03/064052 device without introducing other innovations would not have improved the separator because the magnetic rods created the particle capture force to counteract and to overcome the slurry flow that would otherwise engulf the particles and prevent their separation. Even though we hoped that flushing the pole faces (inside exterior walls of the separation chamber) with slurry would prevent unwanted particle adherence, we expected to have to introduce further separation means in order to be able to achieve successful separation, so we redesigned the separation chamber of the WO 03/064052 device in a number of fundamental ways, including but not limited to a) removing the magnetic rods; b) placing a first inlet port as an inlet pipe within the separation chamber and directed into the top portion of the separation chamber wherein the first inlet port is not only adapted to transfer a mixture into the separation chamber but is also adapted to sweep the mixture downward along the interior wall toward the bottom portion of the separation chamber; and c) positioning the overflow port adjacent the first inlet port and at the top of the separation chamber. After redesigning the apparatus in

these ways, to our surprise we documented new and unexpectedly improved separation results which are set forth and explained below.

4. First, the present claimed apparatus gave much better product throughput compared with the WO 03/064052 apparatus, in tests which we personally conducted as direct comparisons of the two apparatuses using equivalent slurries. The tests were set up and conducted as follows. Tests with the apparatus in which the separation chamber includes rods, as disclosed in WO 03/064052 A2, (US Patent No. 7360,657, April 22, 2008) were carried out in 2000-2001 under Contract DE-FG02-00ER83008 to the US Department of Energy SBIR (Small Business Innovation Research) Phase I. This work explored the viability of the rods separation technology and resulted in the patent filing and a proposal to scale up the technology in an SBIR Phase II. The Phase II proposal was awarded and the work of scaling up the work with the rods began in 2001 and lasted through 2003. In the course of carrying out the work of Phase II we became aware of the limitations of the rods technology, namely limited throughput and a possibility of plugging including difficulties in releasing the catalysts at the lower end of the rods. We considered removing the rods to increase the throughput but anticipated before attempting same that without the rods we would not be able to remove the catalyst particles simply by sweeping them down the inside wall of the container. To our surprise, when we opened the underflow port at the bottom of the separation vessel, we could sweep the particles out of the vessel without adverse effects of particle buildup, and we had succeeded in inventing a separator which could not have been predicted or designed from the principles of the rods separator, WO 03/064052. In comparing the claimed invention with the cited prior art, we observed results obtained when apparatuses as claimed contained either one or two inlet ports (inlet pipes) adjacent the top of the separation chamber. The present claimed apparatus, with either one or two inlet pipes, gave over 3-1/3 times more product than the apparatus of WO 03/064052 at the same capital cost, and these results were comparable regardless of whether one inlet pipe or two inlet pipes were used. (By comparable results, ash reduction was within two percent when one inlet pipe versus two inlet pipes were used. A recycle ratio is the ratio of underflow to overflow--and the higher the ratio, the better the ash reduction.) Stated differently, product throughput of 15 gpm (gallons per minute) for the claimed apparatus proceeded in the above-described tests at the rate of on the order of 7 gpm/FtSq (gallons per minute per Square Foot of chamber cross-section) at an estimated capital cost of $480,000 in 2007 dollars, whereas the throughput rate in the chamber of an apparatus according to WO 03/064052 could not exceed 3 gpm/SqFt of chamber cross-section at an estimated capital cost of $530,000 without

malfunction or unsatisfactory separation. These results explain and corroborate our surprise that a separation chamber without rods, and with at least one inlet pipe within the chamber adjacent the top of the chamber, could significantly outperform a chamber containing magnetic or magnetized rods according to WO 03/064052.

5. Second, to our surprise the [claimed] apparatus overcomes the tendency of the WO 03/064052 apparatus to plug, although the redesigned features of the claimed apparatus would not have been expected to address, let alone improve, the tendency of the rods-containing chamber to plug. For some reason, the design of the claimed separation apparatus creates fluid flows which empirically do not allow blockages at either the underflow or overflow ports, even though we anticipated that upon removing the magnetic rods from the separation chamber the prior art plugging problems could well have worsened, due to any number of potential factors including but not limited to gravity effects, particle agglomeration effects, and unpredictable turbulent flows. However, as evidenced in the work of the Phase I and Phase II SBIR's the claimed apparatus can be run at high throughput with improved separation results and, unexpectedly, little or no plugging of underflow or overflow outlets, in contrast with the apparatus disclosed in WO 03/064052.

6. We further declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

By_____ date_____

Robin R. Oder, PhD

By_____ date_____

Russell E. Jamison